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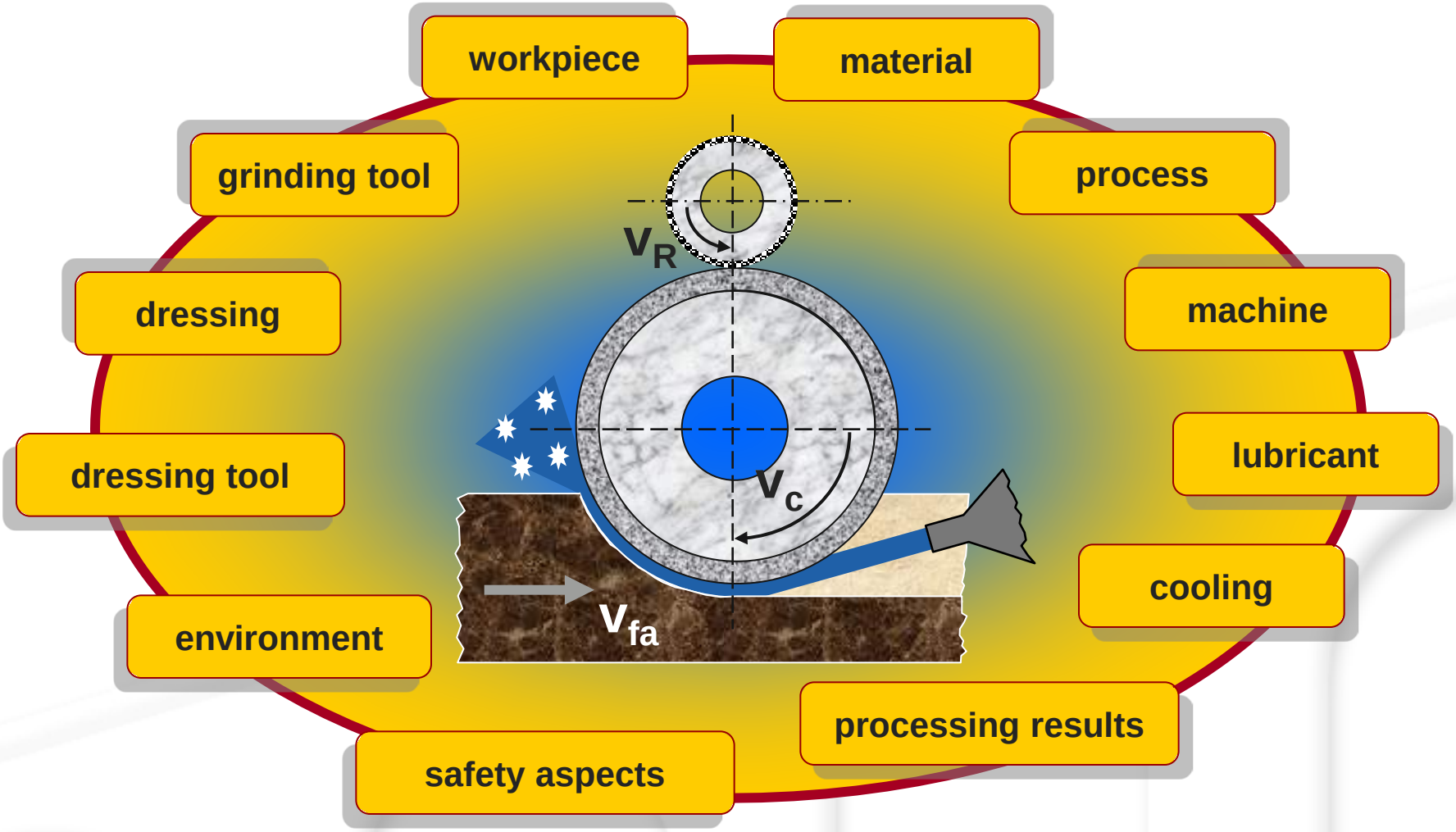
Abrasivos técnicos

Grinding with Superabrasives Tools

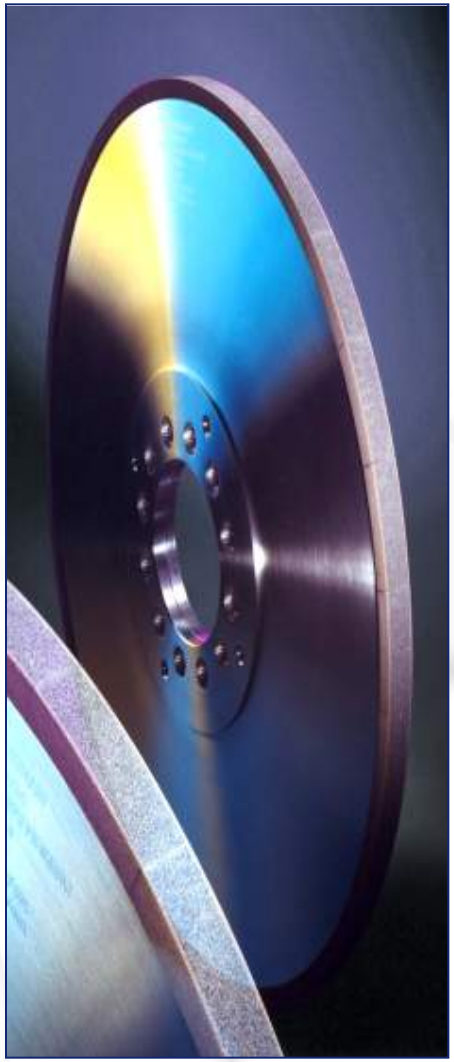
SAINT-GOBAIN
ABRASIVES

Influences on grinding processes



Design of diamond and CBN tools

- relatively thin layer
- attached to bodies made out of
  - aluminium
  - steel
  - resin
  - ceramic
  - composite materials
- adhered by
  - glueing
  - sintering
  - shrinkage
  - electro plating



Contents of grinding layers

all bond types	resin	sintered metal	vitrified	electro plated

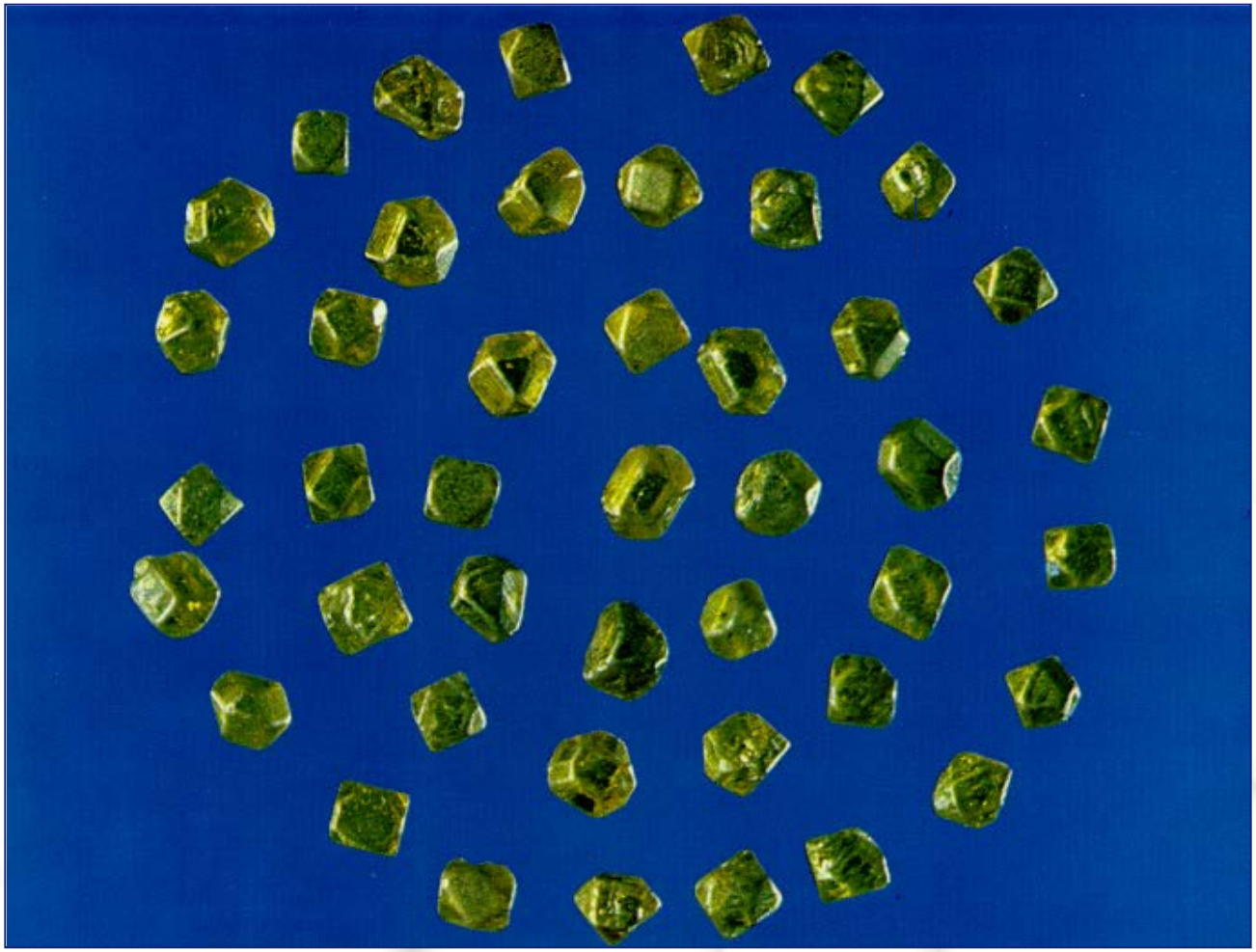
abrasives

- natural dt.
- synthetic dt.
- CBN

filler

- SiC, TiC, B_4C,
- Al_2O_3, SiO_2 ,
- metals
- lubricants

Abrasives are a grinding tool best friends



Most important factor in a layer are ...

... the *abrasives* !

And not the *bond* !

Lattice structures of graphite and boron nitride, diamond and cubic boron nitride

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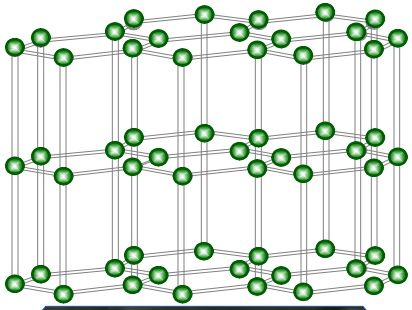
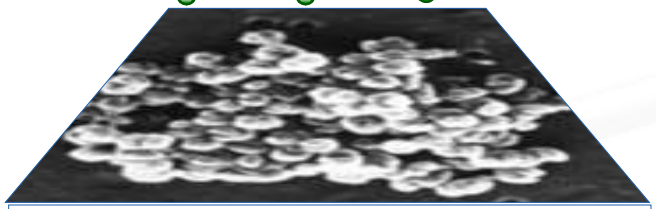
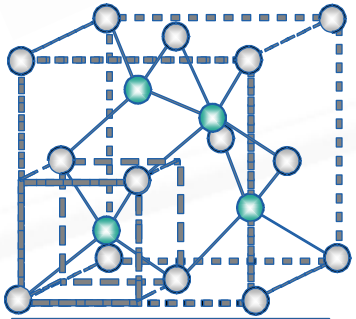
HIGH PRESSURE – HIGH TEMPERATURE SYNTHESIS

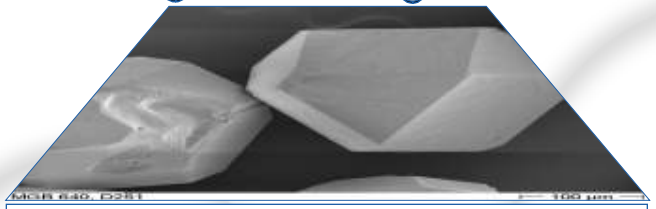




C - graphite
BN - boron nitride

hexagonal lattice structure





C - diamond
cBN - cubic boron nitride

cubic lattice structure

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How a *High-Pressure - High-Temperature Synthesis* works ...

ϑ

synthesis parameters diamonds:

$\vartheta \approx 1.750$ K

$p \approx$ 5,4 M Pa

$t \approx$ 4 .. 8 h

preliminary condition:
catalysators like Fe, Ni, Co, Mn in order to get carbon out of the graphite

Features of diamond and CBN crystals

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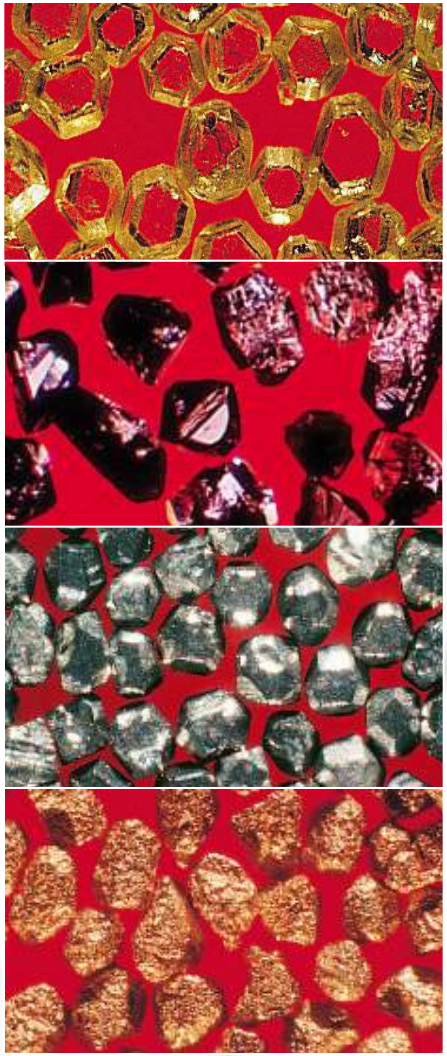
To use abrasives at their best it is necessary to know details about

- grit size and mean distribution
- grit shape
- surface roughness
- coating
- inclusions
- fracture strength
- toughness index
- heat diversion



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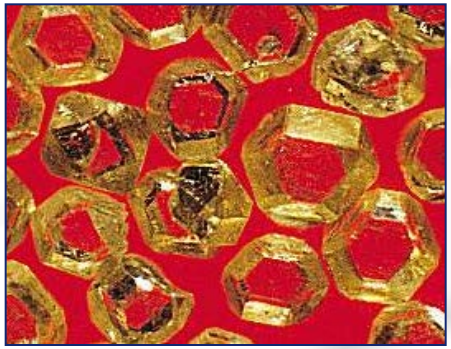
International standardization of grit sizes for diamond and CBN

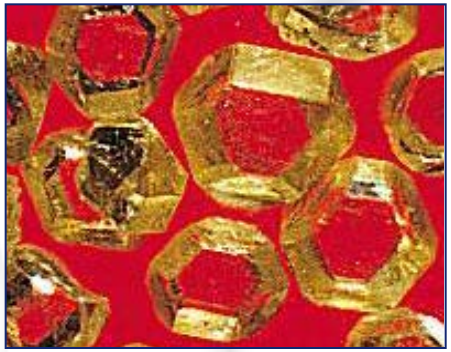
International standardization of grit sizes for diamond and cubic boron nitrid									
Nomenclature of sieved grit sizes							fine grit sizes *)		
DIAMOND FEPA - Standard **narrow**	**wide**	**CBN** FEPA - Standard **narrow**	**wide**	**DIAMOND + CBN** US - Standard **narrow**	**wide**	mesh width acc. ISO6106, DIN848-1	diamond marking SGA	CBN marking SGA	grit size µm
D 1181	D 1182	B 1181	B 1182	16/ 18	16/20	1180/1000	D 25		32-52
D 1001		B 1001		18/ 20		1000/ 850	D 20 B	B 30	30-40
D 851	D 852	B 851	B 852	20/ 25	20/30	850/ 710	D 20 A		25-30
D 711		B 711		25/ 30		710/ 600	D 15		10-25
D 601	D 602	B 601	B 602	30/ 35	30/40	600/ 500	D 15 C		20-25
D 501		B 501		35/ 40		500/ 425	D 15 B	B15	15-20
D 426	D 427	B 426	B 427	40/ 45	40/50	425/ 355	D 15 A	B 9	10-15
D 356		B 356		45/ 50		355/ 300	D 7	B 6	5-10
D 301		B 301		50/ 60		300/ 250	D 3	B 3	2- 5
D 251	D 252	B 251	B 252	60/ 70		250/ 212	D 1	B 1	1- 2
D 213		B 213		70/ 80		212/ 180	D 0,7		0,5- 1
D 181		B 181		80/100		180/ 150	D 0,25		< 0,5
D 151		B 151		100/120		150/ 125			
D 126		B 126		120/140		125/ 106			
D 107		B 107		140/170		106/ 90			
D 91		B 91		170/200		90/ 75			
D 76		B 76		200/230		75/ 63			
D 64		B 64		230/270		63/ 53			
D 54		B 54		270/325		53/ 45			
D 46		B 46		325/400		45/ 38			

◤ grit sizes recommended by SGA

*) similar to FEPA Standard

FEPA: Federation Europeenne des Fabricants de Produits Abrasifs





Mean distribution of grit sizes

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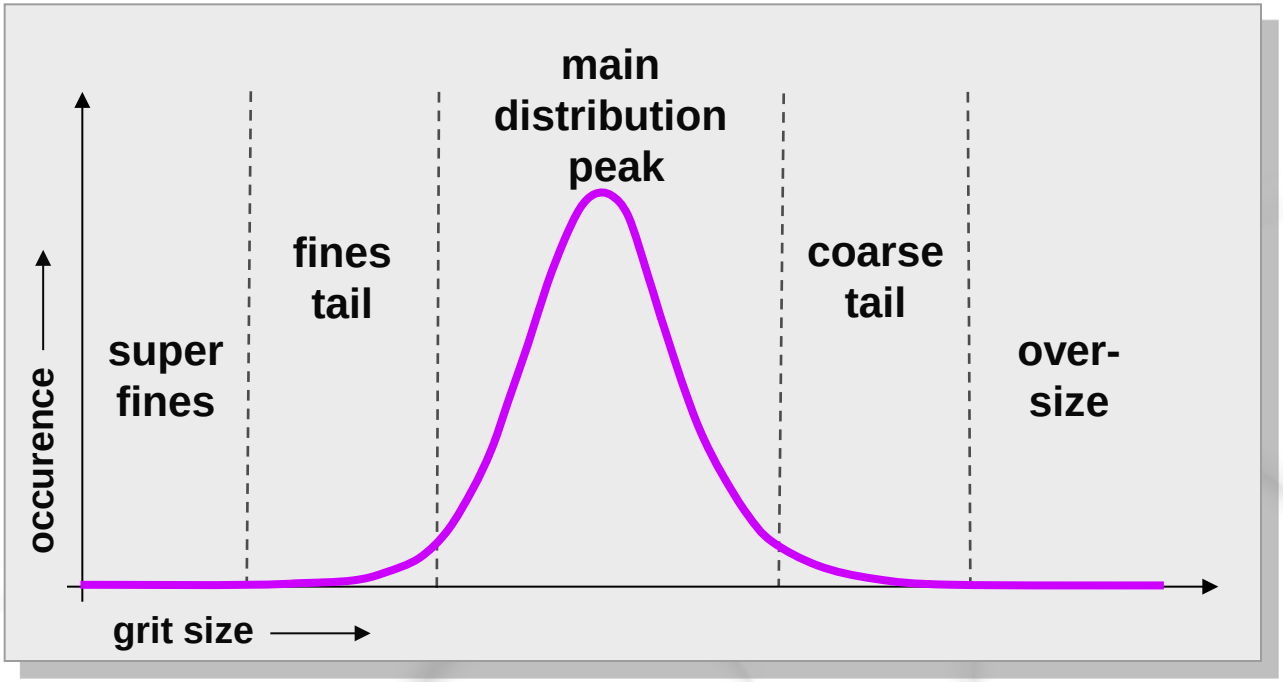
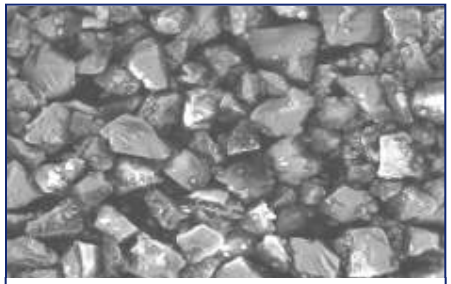
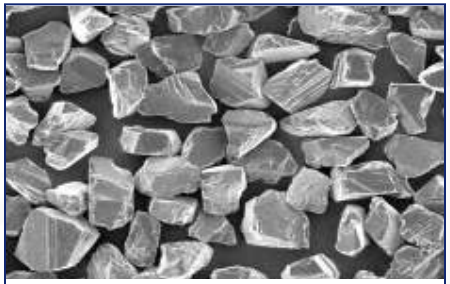
As closer the size of crystals per grit size is as better the grinding result will be

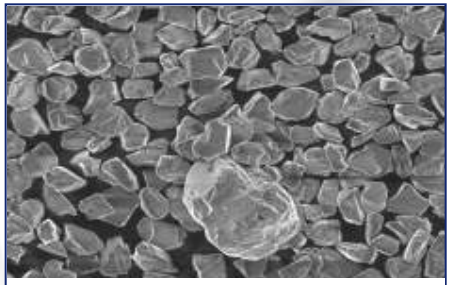




superfines, low quality



on size, high quality



oversize, low quality

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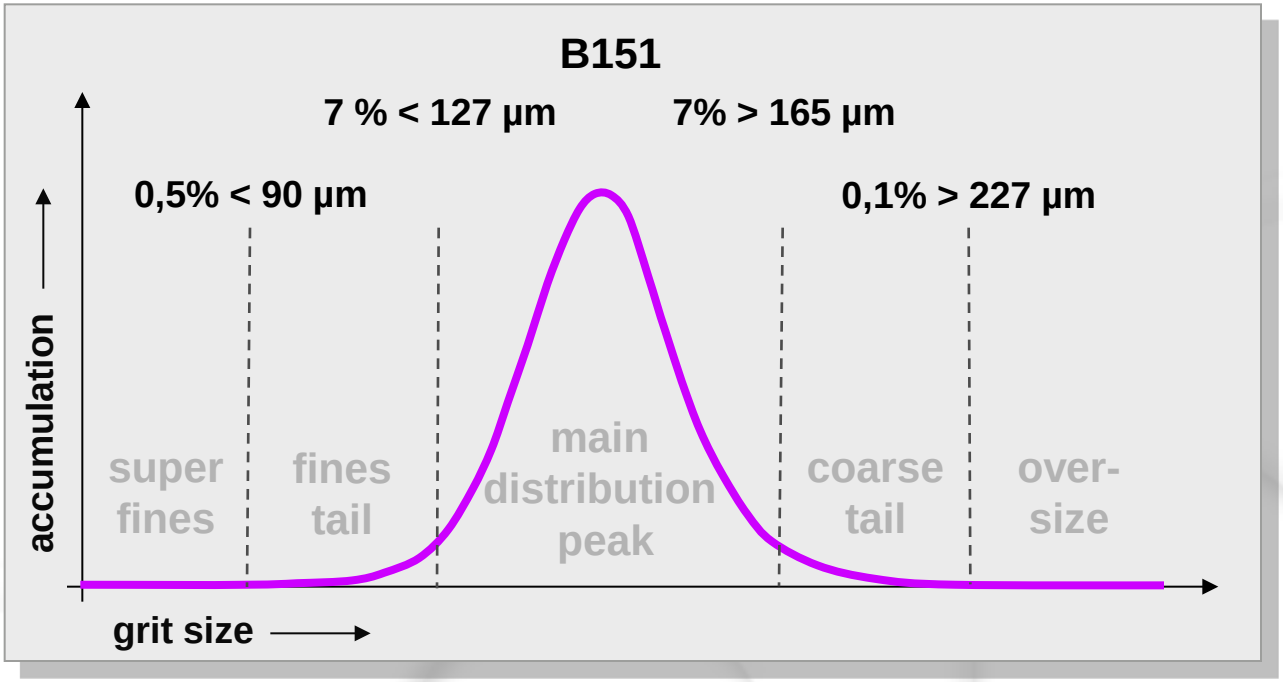
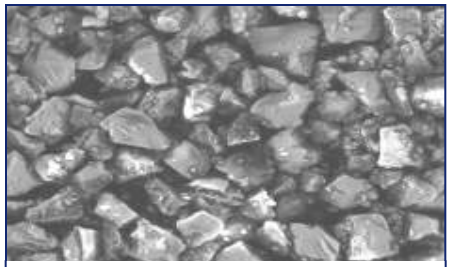
cBN and diamond crystals

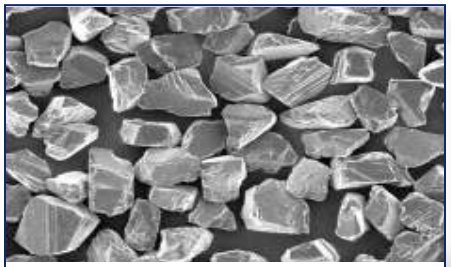
Mean distribution of grit sizes – example

Exemplary for grit size B151

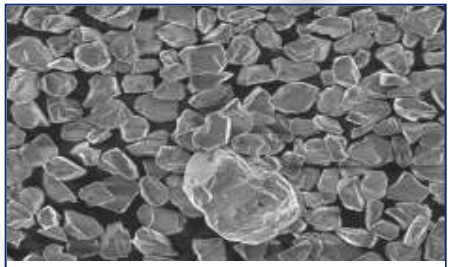




superfines, low quality

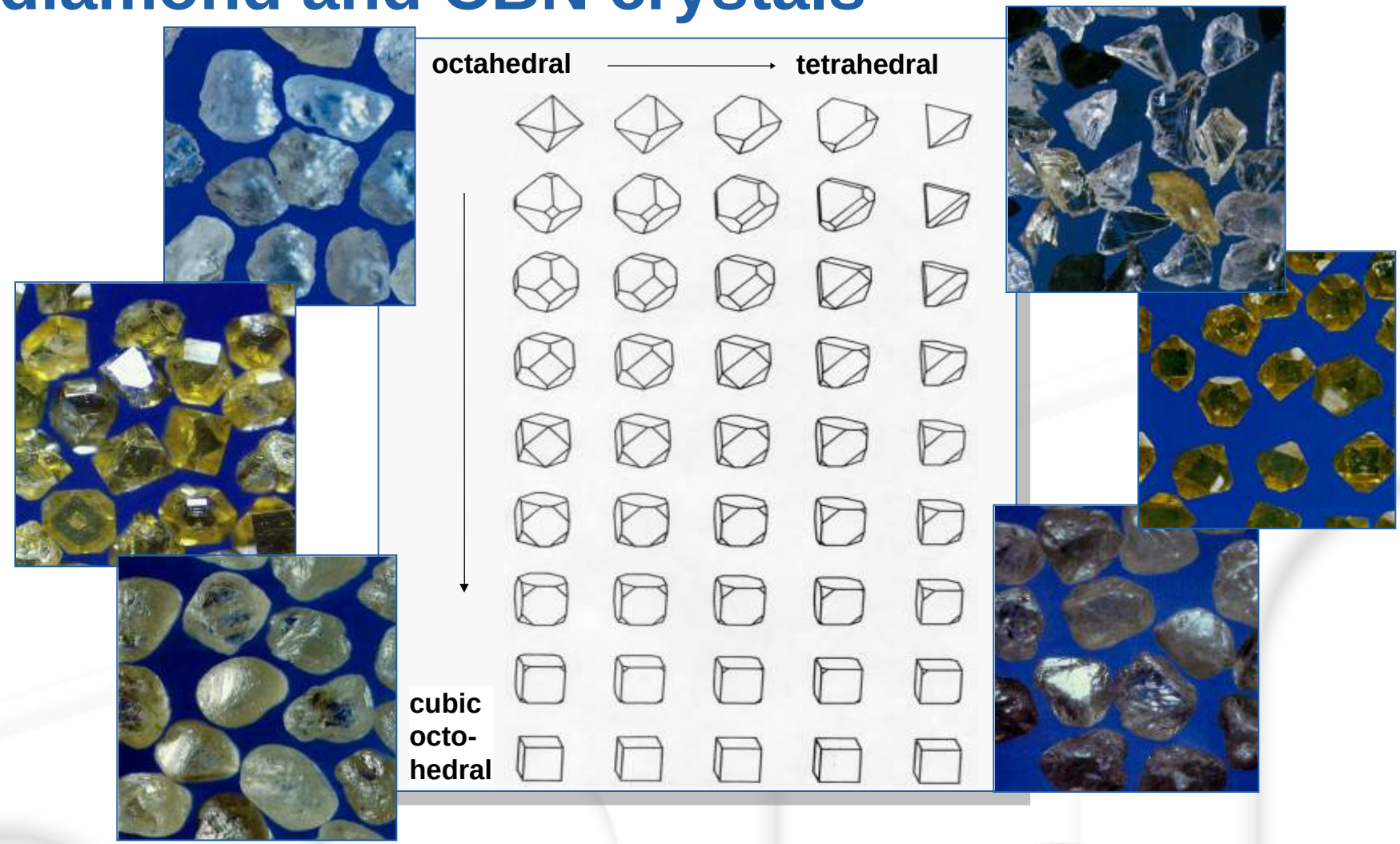


on size, high quality



oversize, low quality

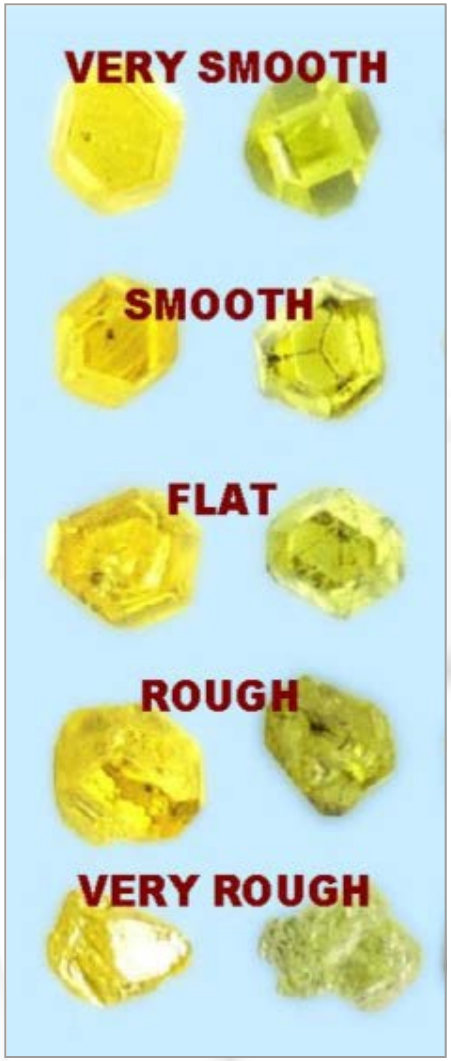
Geometrical shapes of diamond and CBN crystals



Surface roughness of diamond and CBN crystals

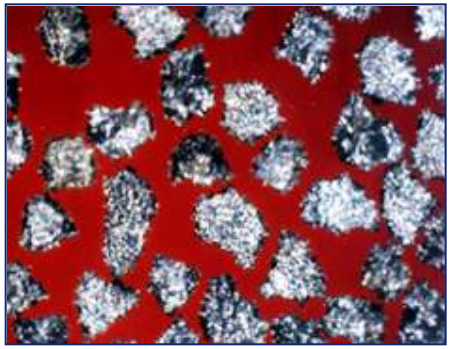
The surface roughness of diamond or CBN grits is an indicator for

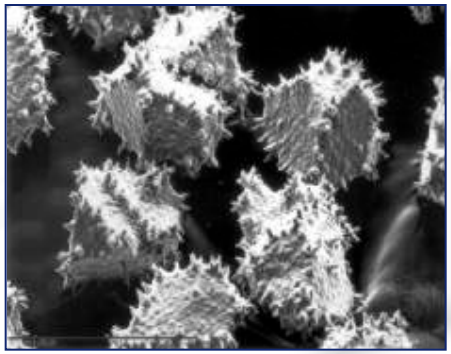
- the retaining behaviour inside the bond and/or the coating
- the breakdown behaviour
- the shaping of cutting edges and the cutting behaviour

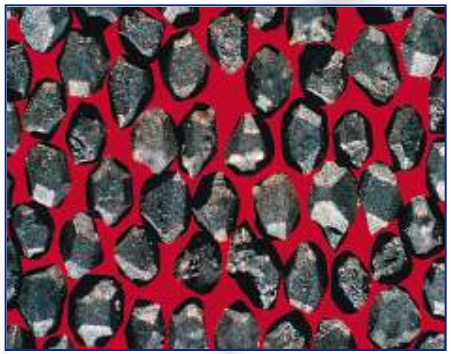


Coatings for diamond and CBN crystals

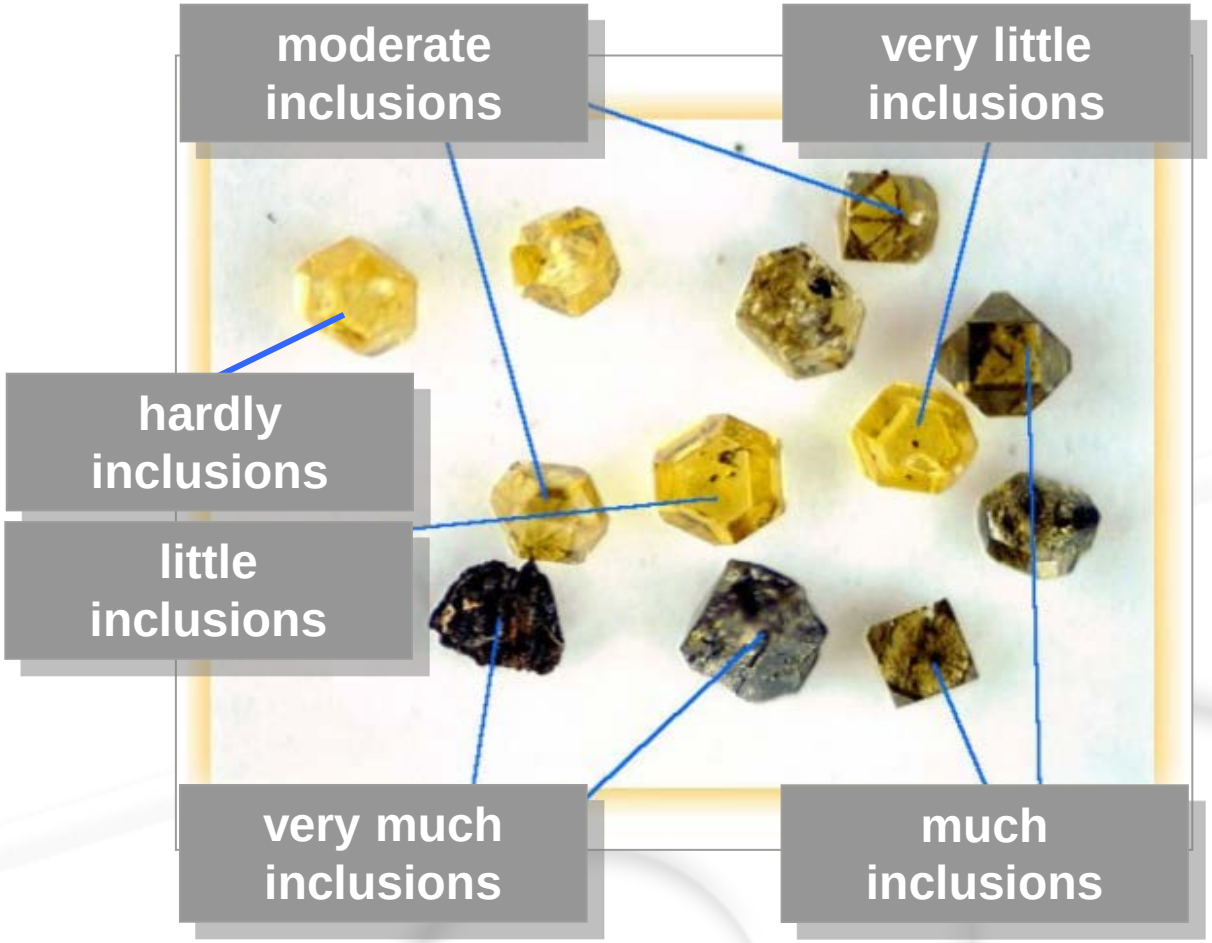
- tasks of coatings are
  - increase of mechanical clamping
  - heat diversion
- coatings can be made out of
  - Ag – coating
  - Cr – spikes
  - Cu – coating
  - Ni – coating
  - Ni/P – coating
  - Ti – coating
  - glass – coating
- guarantor for best use is the adaption of
  - bond
  - coating
  - grit shape
  - grit toughness





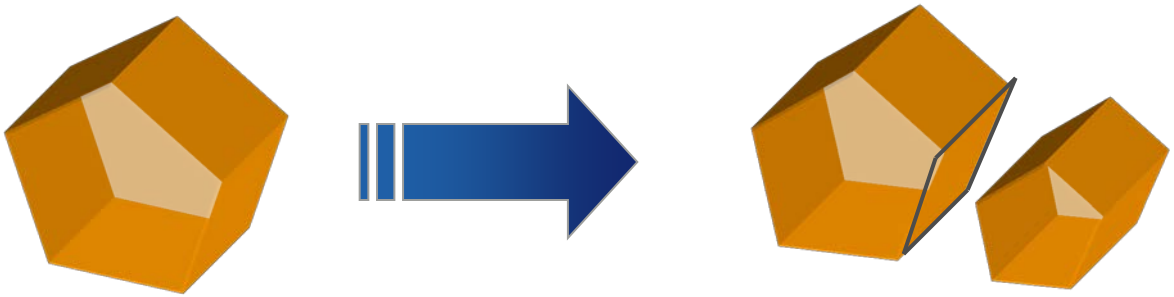


Inclusions inside of diamond and CBN crystals

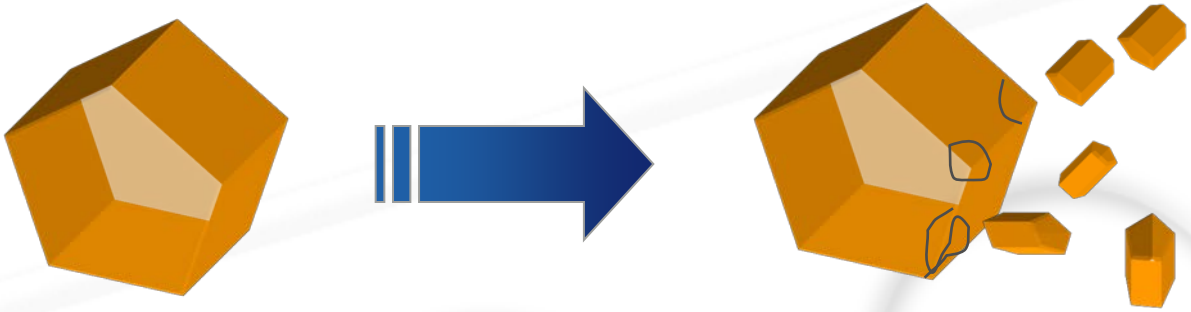


Inclusions may cause the break-down of abrasives during a grinding process

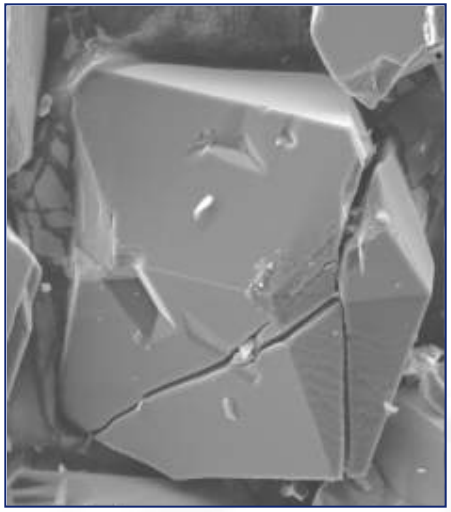
Breakdown behaviour of diamond and CBN crystals

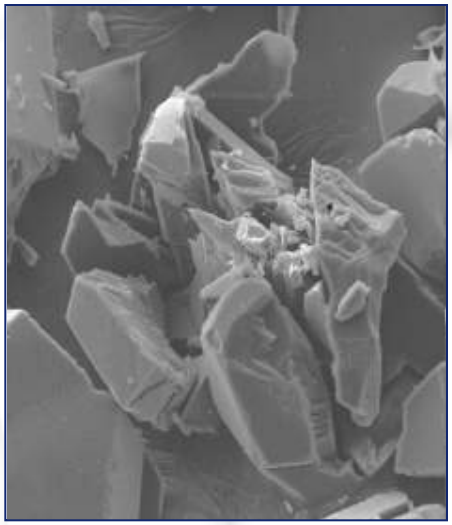


- monocrystalline breakdown

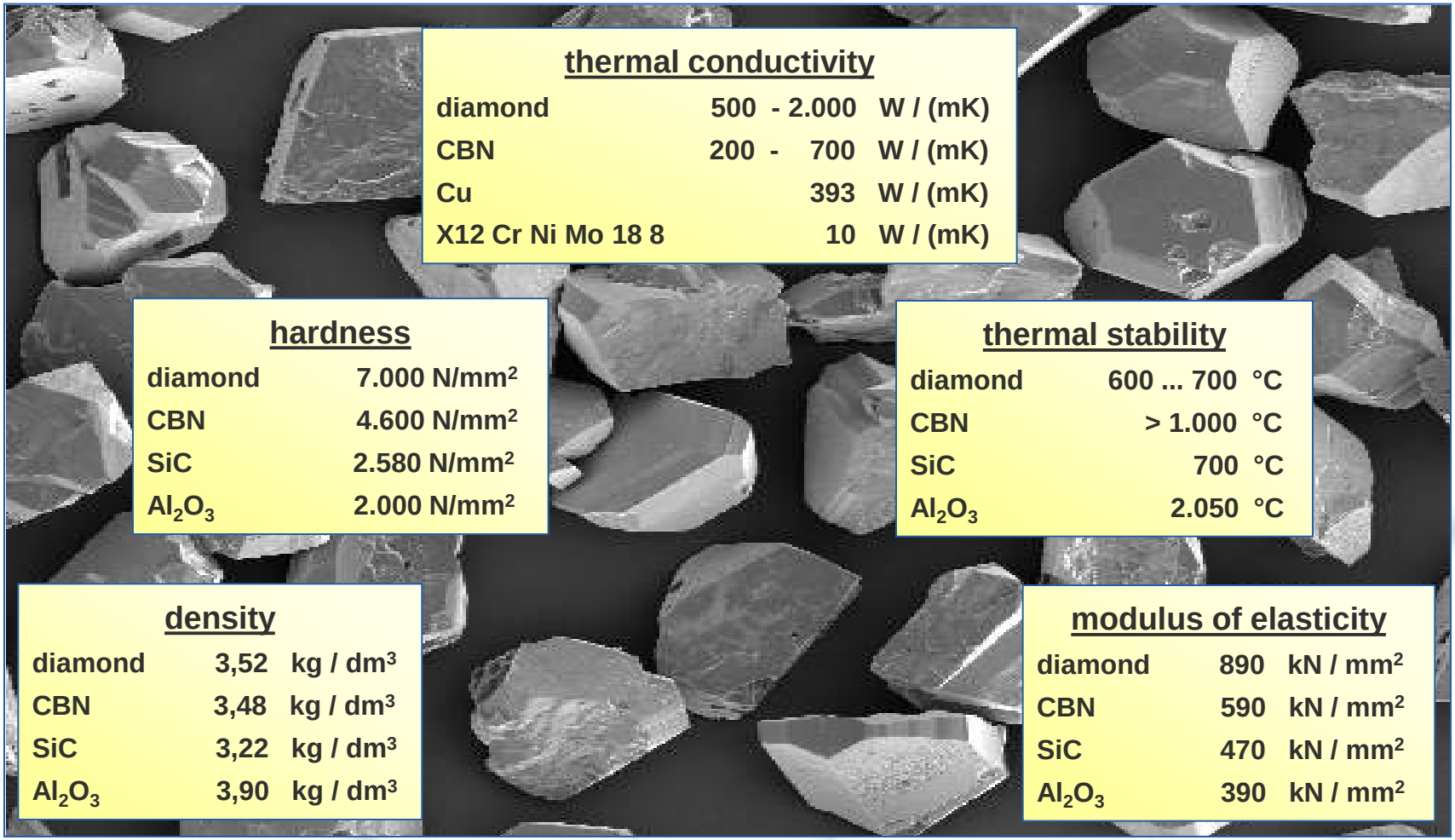


- microcrystalline breakdown





Properties of abrasives



thermal conductivity

diamond	500 - 2.000	W / (mK)
CBN	200 - 700	W / (mK)
Cu	393	W / (mK)
X12 Cr Ni Mo 18 8	10	W / (mK)

hardness

diamond	7.000 N/mm^2
CBN	4.600 N/mm^2
SiC	2.580 N/mm^2
Al_2O_3	2.000 N/mm^2

thermal stability

diamond	600 ... 700	°C
CBN	> 1.000	°C
SiC	700	°C
Al_2O_3	2.050	°C

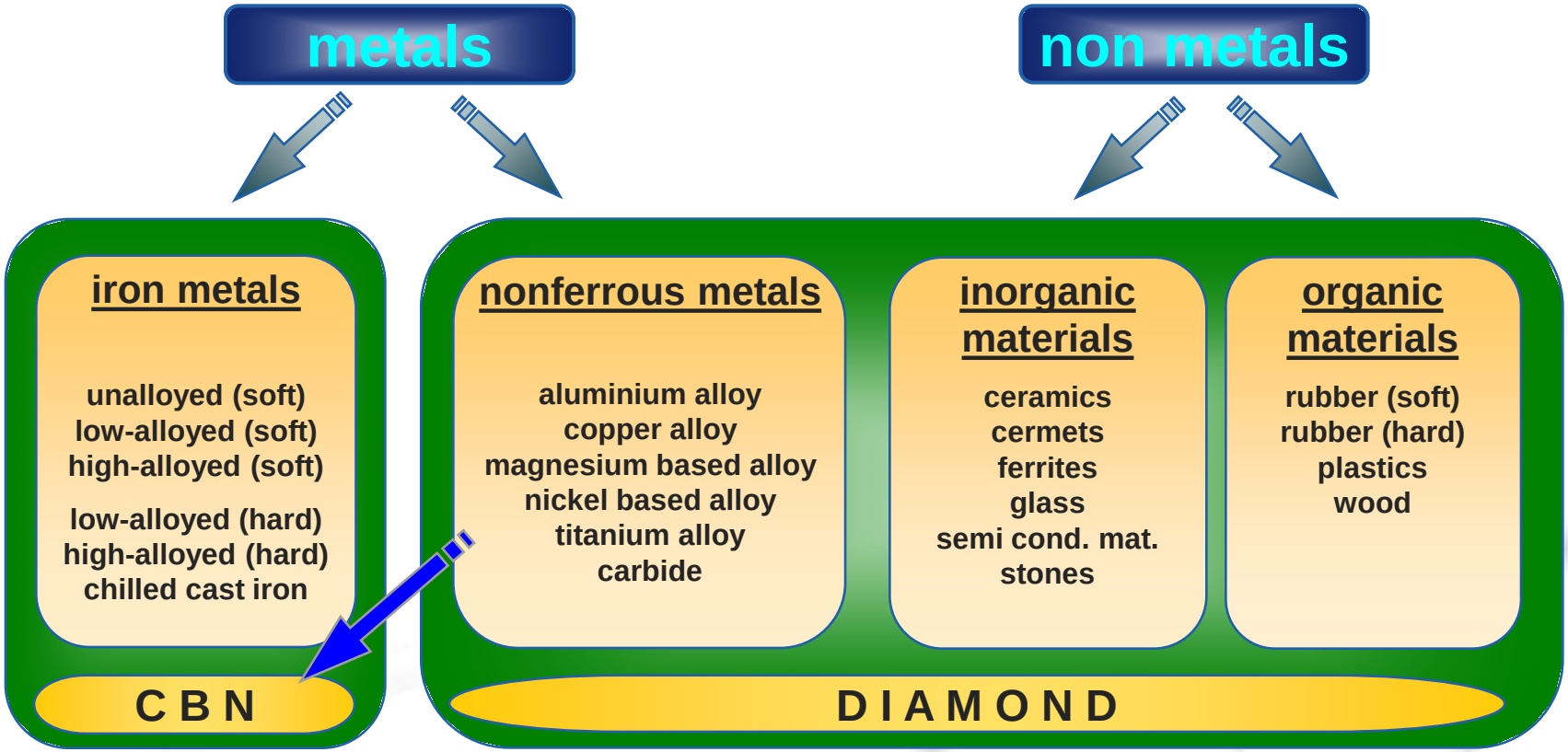
density

diamond	3,52	kg / dm^3
CBN	3,48	kg / dm^3
SiC	3,22	kg / dm^3
Al_2O_3	3,90	kg / dm^3

modulus of elasticity

diamond	890	kN / mm^2
CBN	590	kN / mm^2
SiC	470	kN / mm^2
Al_2O_3	390	kN / mm^2

Where to use CBN and diamonds



Contents of grinding layers

all bond types	resin	sintered metal	vitrified	electro plated
abrasives - natural dt. - synthetic dt. - CBN **filler** - SiC, TiC, B_4C, - Al_2O_3, SiO_2 , - metals - lubricants	**powder** - epoxy resin - melanin - phenolics - polyimides **liquids** - epoxy resin - glues - phenolics	**powder** - Ag, Co, Cu, - Fe, Ni, Sn, - bronzes - etc. ...	**powder** - vitreous frits - ceramics - metal oxyds - nitrate - waxes **liquids** -binder	**powder** - Ag salt - Au salt - Co salt - Cu salt - Ni salt **liquids** - acids - leaches - additives

Bond systems for grinding wheels

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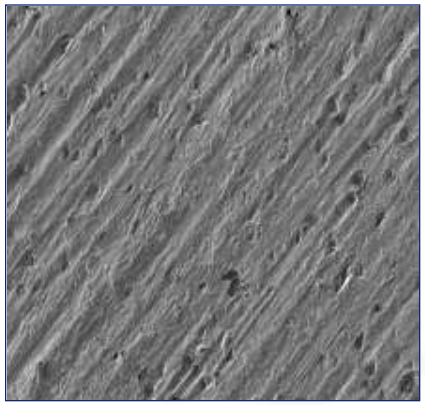
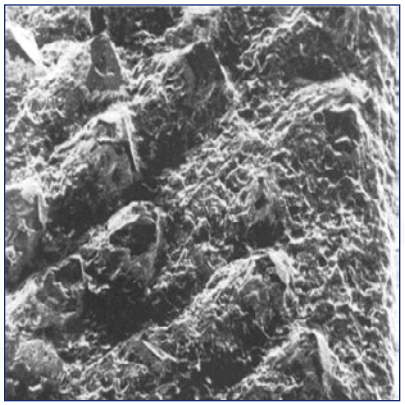
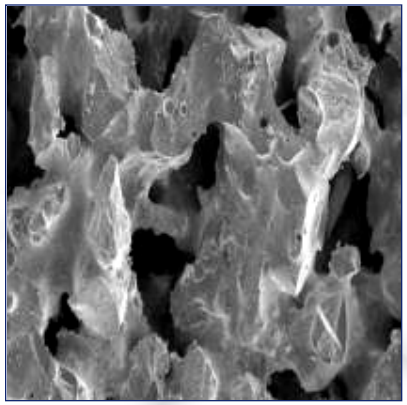
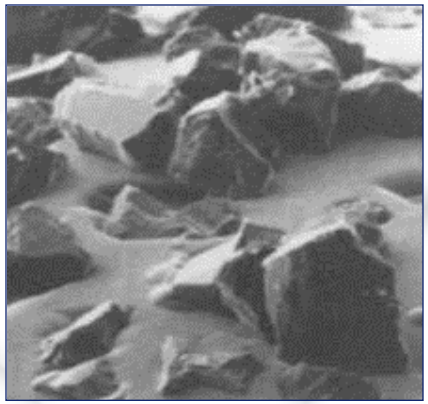
resin	sinter metal	vitrified	electro plated
• phenolic resin • polyimide	• bronze • brass • carbide	• basis silicate - vitreous - cristaline	• chemical • electrolytical

multiple resp. volume layer

single layer

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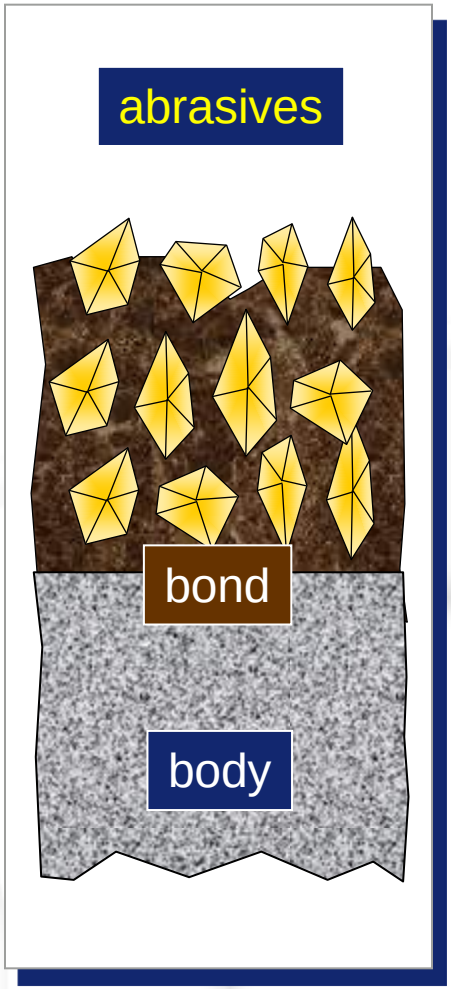
Tasks of bonds

- retaining of the abrasives,
  as long as grit edges are sharp
- releasing of the abrasives,
  after the grit edges become dull or flaten
- resistance against abrasion,
  to ensure a high profile accuracy
- warranty of „own“ wear,
  to get the necessary grit protrusion
- heat transfer,
  to avoid grit damages
- good properties for easy profiling,
  to avoid needless secondary processing time



Knowledge about bond components

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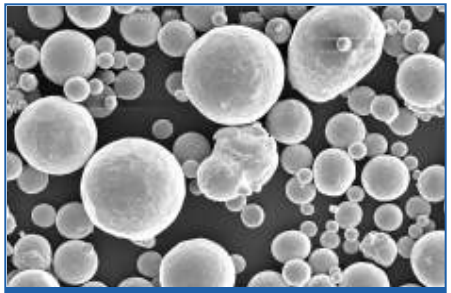
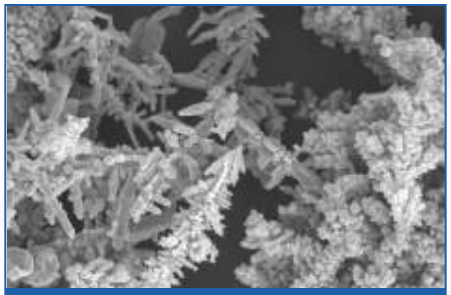
Bonds and their properties will be influenced strongly by the

- structure
- purity
- surface
- grit size
- particle size distribution

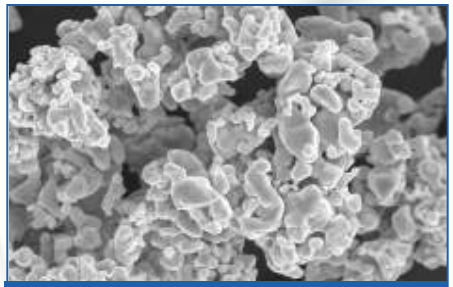
of each single component



bronze powder (89:11) -- 50 µm --



copper powder -- 10 µm --



silver powder -- 10 µm --

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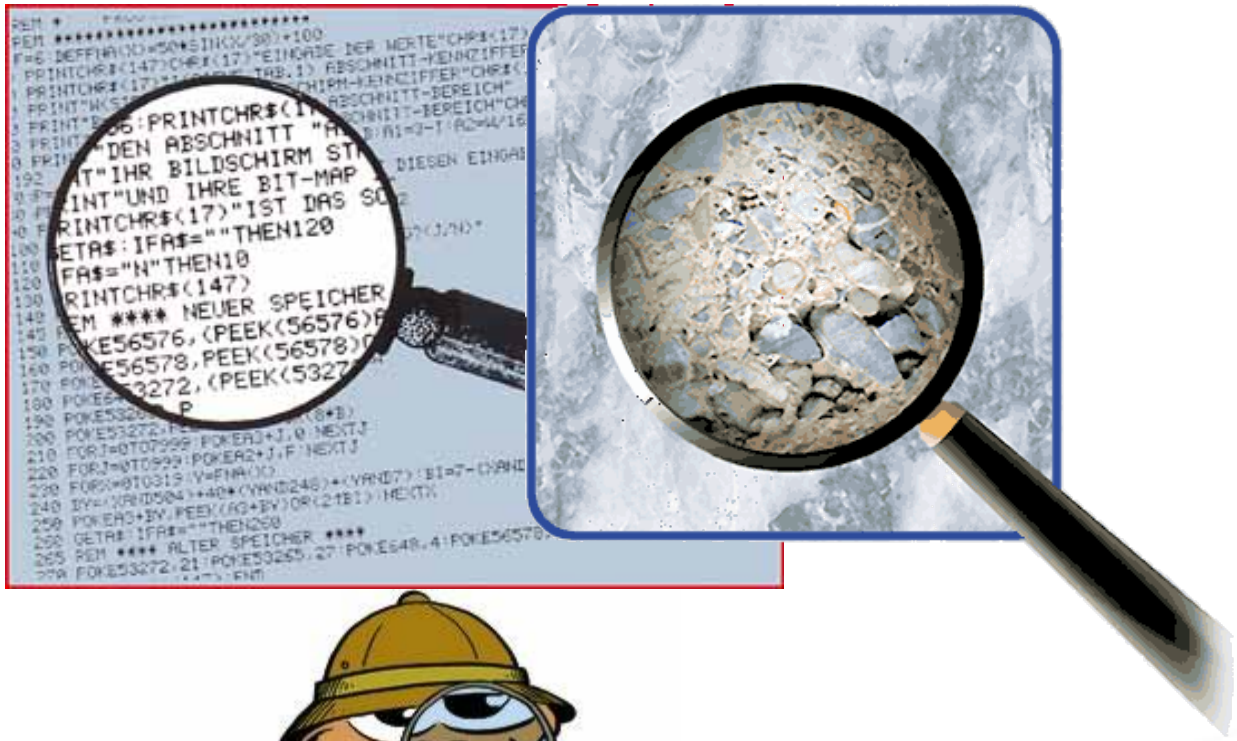

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